CLAIMS

What is claimed is:

1. A method for transporting gas, comprising:

dissolving the gas in an emulsion comprising a fluorinated hydrocarbon, a surfactant and an aqueous electrolyte with a pH of at most 4 or at least 9; and

contacting the emulsion with an electrode.

2. The method of claim 1, wherein:

the aqueous electrolyte has a pH of at most 3.

3. The method of claim 1, wherein:

the aqueous electrolyte comprises an acid dissolved in water, and the acid comprises a member selected from the group consisting of:

H_2SO_4, HNO_3, $HClO_4$, H_3PO_3, H_3PO_4, HCl, HBr, HI, CH_3CO_2H, CCl_3CO_2H, CF_3CO_2H, and mixtures thereof.

4. The method of claim 1, wherein:

the aqueous electrolyte comprises an aqueous solution of H_2SO_4.

5. The method of claim 1, wherein:

the aqueous electrolyte has a pH of at least 10.

6. The method of claim 1, wherein:

the aqueous electrolyte comprises a base dissolved in water, and the base comprises a member selected from the group consisting of:

LiOH, NaOH, KOH, Rb(OH), CsOH, $Mg(OH)_2$, $Ca(OH)_2$, $Sr(OH)_2$, and $Ba(OH)_2$, and mixtures thereof.

7. The method of claim 1, wherein:

the fluorinated solvent is selected from the group consisting of:

$(C_nF_{2n+1})Si(OCH_3)_3$; $(C_nF_{2n+1})_2Si(OCH_3)_2$; $(C_nF_{2n+1})CH_2OC(O)CH_3$; $CF_3[OCF_2CF_2]_nOCF_3$; $CF_3[OCF_2CF_2]_nOCF_2Cl$; $CF_3[OCF_2CF_2]_nOCF_2Br$; $CF_3[OCF_2CF_2]_nCF_2H$; $CF_3[OCF_2CF_2]_nF$; $CF_3[OCF_2CF_2]_nCl$; $CF_3[OCF_2CF_2]_nBr$; $CF_3[OCF_2CF_2]_nH$; $CF_3CF_2[OCF_2CF_2]_nF$; $CF_3CF_2[OCF_2CF_2]_nCl$; $CF_3CF_2[OCF_2CF_2]_nBr$; $CF_3CF_2[OCF_2CF_2]_nH$; $CF_3CHF[OCF_2CF_2]_nF$; $CF_3CHF[OCF_2CF_2]_nCl$; $CF_3CHF[OCF_2CF_2]_nBr$; $CF_3CHF[OCF_2CF_2]_nH$; $CF_3CHF[OCF_2CF(CF_3)]_nF$; $(CF_3)_2CF(CF_2)_nF$; $(CF_3)_2CF(CF_2)_nCl$; $(CF_3)_2CFO(CF_2)_nBr$; $(CF_3)_2CFO(CF_2)_nH$; $(CF_3)_2CFO(CF_2)_nF$; $(CF_3)_2CFO(CF_2)_nCl$; $(CF_3)_2CFO(CF_2)_nBr$; $(CF_3)_2CFO(CF_2)_nH$; C_nF_{2n+2}; $CF_3(CF_2)_nCl$; $CF_3(CF_2)_nHCF_3(CF_2)_nBr$; $N(C_nF_{2n+1})_3$ wherein n is 1 to 20; $C_6F_mH_{6-m}$, $C_6F_mCl_{6-m}$, $C_6F_mBr_{6-m}$, $C_6F_m(CF_3)_{6-m}$, wherein m is 1 to 6; and mixtures thereof.

8. The method of claim 1, wherein:

the fluorinated solvent is selected from the group consisting of:

$CF_3(CF_2)_7Br$; $(CF_3)_2CF(CF_2)_4Cl$; $(CF_3)_2CFO(CF_2)_6F$; perfluorobutyltetrahydrofuran; perfluoropropyltetrahydropyran; C_8F_{18}; $CF_3CFBrCF_2Br$; $(CF_3)_2CF(CF_2)_4Br$; $[(CF_3)_2CFOCF_2CF_2]_2$; C_9F_{20}; C_6F_6; $CF_3CHF[OCF_2CF(CF_3)]_3F$; $(CF_3)_2CF(CF_2)_6Cl$; $C_{10}F_{16}$; $CF_3CHF[OCF_2CF(CF_3)]_4F$; perfluorotetrahydrodicyclopentadiene; $[(CF_3)_2CFO(CF_2)_4]_2$; perfluorodecalin; $CF_3CHF[OCF_2CF(CF_3)]_5F$; perfluorodimethyladamantane; $N(C_4F_9)_3$; perfluoromethyldecalin; $C_6H_4(CF_3)_2$; and $CF_3CHF[OCF_2CF(CF_3)]_9F$, and mixtures thereof.

9. The method of claim 1, wherein:

the fluorinated solvent is perfluorodecaline.

10. The method of claim 1, wherein:

the surfactant is selected from the group consisting of:

$F(CF_2CF_2)_y(CH_2CH_2O)_xH$, wherein y is 1 to 10, and x is 0 to 25; $((F(CF_2CF_2)_yCH_2CH_2)_xP(O)(ONH_4)_y$, wherein x is 1 or 2, y is 1 or 2, x + y is 3, and z is 1 to

8; $F(CF_2CF_2)_xCH_2CH_2SCH_2CH_2CO_2Li$, wherein x is 1 to 10; $F(CF_2CF_2)_xCH_2CH_2SO_3Y$, wherein x is 1 to 10, and Y is H^+ or NH_4^+; and mixtures thereof.

11. The method of claim 1, wherein:

the surfactant is a mixture of $CF_3(CF_2)_5CH_2CH_2SO_3H$ and $CF_3(CF_2)_5CH_2CH_2SO_3NH_4$.

12. The method of claim 1, wherein:

the volume-to-volume ratio of fluorinated solvent to aqueous electrolyte in the emulsion is from 1:24 to 24:1.

13. The method of claim 1, wherein:

the volume-to-volume ratio of fluorinated solvent to aqueous electrolyte in the emulsion is from 3:24 to 12:24.

14. The method of claim 1, wherein:

the volume-to-volume ratio of fluorinated solvent to aqueous electrolyte in the emulsion is from 1:6 to 5:7.

15. The method of claim 1, wherein:

the volume-to-volume ratio of fluorinated solvent to aqueous electrolyte in the emulsion is from 2:9 to 4:9.

16. The method of claim 1, wherein:

The amount of surfactant in the emulsion is from 0.07% to 3% of the total weight of the emulsion.

17. The method of claim 1, wherein:

The amount of surfactant in the emulsion is from 0.125% to 2% of the total weight of the emulsion.

18. The method of claim 1, wherein:

The amount of surfactant in the emulsion is from 0.5% to 1% of the total weight of the emulsion.

19. The method of claim 1, wherein:

the gas comprises oxygen.

20. A composition for delivering gas and ions to an electrode, comprising:

an emulsion comprising:

a fluorinated hydrocarbon;

a surfactant; and

an aqueous electrolyte with a pH of at most 4 or at least 9.

21. The composition of claim 20, wherein:

the aqueous electrolyte has a pH of at most 3.

22. The composition of claim 20, wherein:

the aqueous electrolyte has a pH of at most 1.

23. The composition of claim 20, wherein:

the aqueous electrolyte comprises a member selected from the group consisting of:

H_2SO_4, HNO_3, $HClO_4$, H_3PO_3, H_3PO_4, HCl, HBr, HI, CH_3CO_2H, CCl_3CO_2H, CF_3CO_2H, and mixtures thereof.

24. The composition of claim 20, wherein:

the electrolyte comprises an aqueous solution of H_2SO_4.

25. The composition of claim 20, wherein:

the aqueous electrolyte has a pH of at most 10.

26. The composition of claim 20, wherein:

the aqueous electrolyte comprises a member selected from the group consisting of:

LiOH, NaOH, KOH, Rb(OH), CsOH, $Mg(OH)_2$, $Ca(OH)_2$, $Sr(OH)_2$, and $Ba(OH)_2$, and mixtures thereof.

27. The composition of claim 20, wherein:

the fluorinated solvent is selected from the group consisting of:

$(C_nF_{2n+1})Si(OCH_3)_3$; $(C_nF_{2n+1})_2Si(OCH_3)_2$; $(C_nF_{2n+1})CH_2OC(O)CH_3$; $CF_3[OCF_2CF_2]_nOCF_3$; $CF_3[OCF_2CF_2]_nOCF_2Cl$; $CF_3[OCF_2CF_2]_nOCF_2Br$; $CF_3[OCF_2CF_2]_nCF_2H$; $CF_3[OCF_2CF_2]_nF$; $CF_3[OCF_2CF_2]_nCl$; $CF_3[OCF_2CF_2]_nBr$; $CF_3[OCF_2CF_2]_nH$; $CF_3CF_2[OCF_2CF_2]_nF$; $CF_3CF_2[OCF_2CF_2]_nCl$; $CF_3CF_2[OCF_2CF_2]_nBr$; $CF_3CF_2[OCF_2CF_2]_nH$; $CF_3CHF[OCF_2CF_2]_nF$; $CF_3CHF[OCF_2CF_2]_nCl$; $CF_3CHF[OCF_2CF_2]_nBr$; $CF_3CHF[OCF_2CF_2]_nH$; $CF_3CHF[OCF_2CF(CF_3)]_nF$; $(CF_3)_2CF(CF_2)_nF$; $(CF_3)_2CF(CF_2)_nCl$; $(CF_3)_2CFO(CF_2)_nBr$; $(CF_3)_2CFO(CF_2)_nH$; $(CF_3)_2CFO(CF_2)_nF$; $(CF_3)_2CFO(CF_2)_nCl$; $(CF_3)_2CFO(CF_2)_nBr$; $(CF_3)_2CFO(CF_2)_nH$; C_nF_{2n+2}; $CF_3(CF_2)_nCl$; $CF_3(CF_2)_nHCF_3(CF_2)_nBr$; $N(C_nF_{2n+1})_3$ wherein n is 1 to 20; $C_6F_mH_{6-m}$, $C_6F_mCl_{6-m}$, $C_6F_mBr_{6-m}$, $C_6F_m(CF_3)_{6-m}$, wherein m is 1 to 6; and mixtures thereof.

28. The composition of claim 20, wherein:

the fluorinated solvent is selected from the group consisting of:

$CF_3(CF_2)_7Br$; $(CF_3)_2CF(CF_2)_4Cl$; $(CF_3)_2CFO(CF_2)_6F$; perfluorobutyltetrahydrofuran; perfluoropropyltetrahydropyran; C_8F_{18}; $CF_3CFBrCF_2Br$;

$(CF_3)_2CF(CF_2)_4Br$; $[(CF_3)_2CFOCF_2CF_2]_2$; C_9F_{20}; C_6F_6; $CF_3CHF[OCF_2CF(CF_3)]_3F$; $(CF_3)_2CF(CF_2)_6Cl$; $C_{10}F_{16}$; $CF_3CHF[OCF_2CF(CF_3)]_4F$; perfluorotetrahydrodicyclopentadiene; $[(CF_3)_2CFO(CF_2)_4]_2$; perfluorodecalin; $CF_3CHF[OCF_2CF(CF_3)]_5F$; perfluorodimethyladamantane; $N(C_4F_9)_3$; perfluoromethyldecalin; $C_6H_4(CF_3)_2$; and $CF_3CHF[OCF_2CF(CF_3)]_9F$; and mixtures thereof.

29. The composition of claim 20, wherein:

the fluorinated solvent is perfluorodecaline.

30. The composition of claim 20, wherein:

the surfactant is selected from the group consisting of:

$F(CF_2CF_2)_y(CH_2CH_2O)_xH$, wherein y is 1 to 10, and x is 0 to 25; $((F(CF_2CF_2)_yCH_2CH_2)_xP(O)(ONH_4)_y$, wherein x is 1 or 2, y is 1 or 2, x + y is 3, and z is 1 to 8; $F(CF_2CF_2)_xCH_2CH_2SCH_2CH_2CO_2Li$, wherein x is 1 to 10; $F(CF_2CF_2)_xCH_2CH_2SO_3Y$, wherein x is 1 to 10, and Y is H^+ or NH_4^+; and mixtures thereof.

31. The composition of claim 20, wherein:

the surfactant is a mixture of $CF_3(CF_2)_5CH_2CH_2SO_3H$ and $CF_3(CF_2)_5CH_2CH_2SO_3NH_4$.

32. The composition of claim 20, wherein:

the volume-to-volume ratio of fluorinated solvent to aqueous electrolyte in the emulsion is from 1:24 to 24:1.

33. The composition of claim 20, wherein:

the volume-to-volume ratio of fluorinated solvent to aqueous electrolyte in the emulsion is from 3:24 to 12:24.

34. The composition of claim 20, wherein:

the volume-to-volume ratio of fluorinated solvent to aqueous electrolyte in the emulsion is from 1:6 to 5:7.

35. The composition of claim 20, wherein:

the volume-to-volume ratio of fluorinated solvent to aqueous electrolyte in the emulsion is from 2:9 to 4:9.

36. The composition of claim 20, wherein:

the amount of surfactant in the emulsion is from 0.07% to 3% of the total weight of the emulsion.

37. The composition of claim 20, wherein:

the amount of surfactant in the emulsion is from 0.125% to 2% of the total weight of the emulsion.

38. The composition of claim 20, wherein:

The amount of surfactant in the emulsion is from 0.5% to 1% of the total weight of the emulsion.

39. A fuel cell for the generation of electricity, comprising:

a) an anode;

b) a cathode; and

c) a composition in contact with at least one of the anode and the cathode comprising:

an emulsion comprising a fluorinated solvent, a surfactant and an aqueous electrolyte with a pH of at most 4 or at least 9.

40. The fuel cell of claim 39, wherein:

the fuel cell is a fuel cell wherein the cathode and the anode are separated by a membrane.

41. The fuel cell of claim 39, wherein:

the anode and the cathode are separated by a channel contiguous with at least a portion of each electrode;

such that when a first liquid is contacted with the anode, a second liquid is contacted with the cathode, and the first and the second liquids flow through the channel, a parallel laminar flow is established between the first and the second liquid.

42. The fuel cell of claim 39, wherein:

the composition in contact with the anode further comprises a fuel.

43. The fuel cell of claim 39, wherein:

the composition in contact with the cathode further comprises oxygen.

44. In a fuel cell comprising:

a) an anode; and

b) a cathode;

the improvement comprising:

transporting a gas to at least one of the anode and the cathode by:

dissolving the gas in an emulsion comprising a fluorinated solvent, a surfactant and an aqueous electrolyte with a pH of at most 4 or at least 9; and

contacting the emulsion with at least one of the anode and the cathode.